§10. Steady-State Operation of the SC Current Feeder System for LHD

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Figure 1 shows a control scheme of a helium flow for an SC current feeder system. Each process of the cooling-down, steady state operation and warming-up is controlled by the sequential program that is linked together with the program for the refrigerator system. The PID conpensators for the cryogenic valves and heaters adjust automatically for the manipulated values of the mass flow rates, the liquid helium levels and pressures in the helium flow circuits.

The experiments for the plasma confinements under 1.5 T and the wall conditioning for the vacuum vessel under 0.0875 T had been performed alternately during the first cycle experiments. Figure 2 shows the typical examples of the steady state operation; (a) liquid helium levels in the sub-coolers and current-leads, (b) pressures in the sub-coolers and recovery line, and (c) coil currents for the plasma experiments. Both liquid helium levels in the sub-coolers were well controlled in constant value of 60 % by the heaters. The pressure difference between the sub-cooler and recovery line influences the liquid helium levels in the current-leads. When the current flows through the current-leads, liquid helium levels will be decreased, because of the Joule heating. Therefore, the pressures in the sub-cooler had been adjusted to the suitable values for keeping the liquid helium levels in the current-leads.

The stable operation for the current-leads could be obtained, when the Valve VX shown in Fig. 1 is open. The typical examples are shown in Fig. 3; (a) liquid helium levels in the sub-cooler and current-leads, (b) pressures in the sub-cooler and recovery line, and (c) coil currents for the coil excitation test. The liquid helium between the sub-cooler and current-leads will be equalized by the siphon methods. The liquid helium level of the current-leads could be kept in constant without pressure adjustment in the sub-coolers, whenever the current flows in the current-leads.

Experiments for the plasma confinements were conducted during five months in this year. Total numbers of coil excitations were 124, and total times of the coil excitations were 1134 hours. The SC current feeder system had been operated with no trouble in these periods.

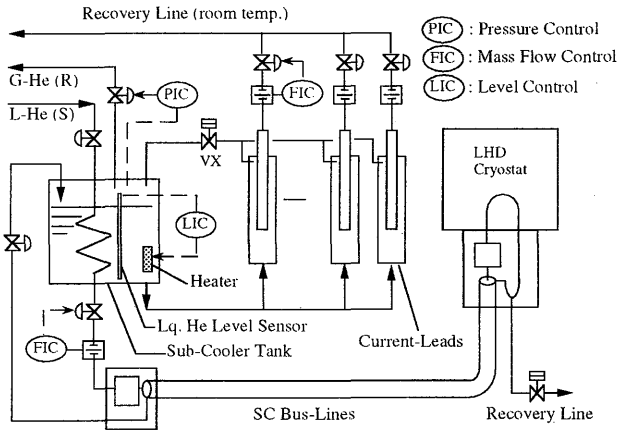

Fig. 1 Control scheme of a helium flow in the SC current feeder system.

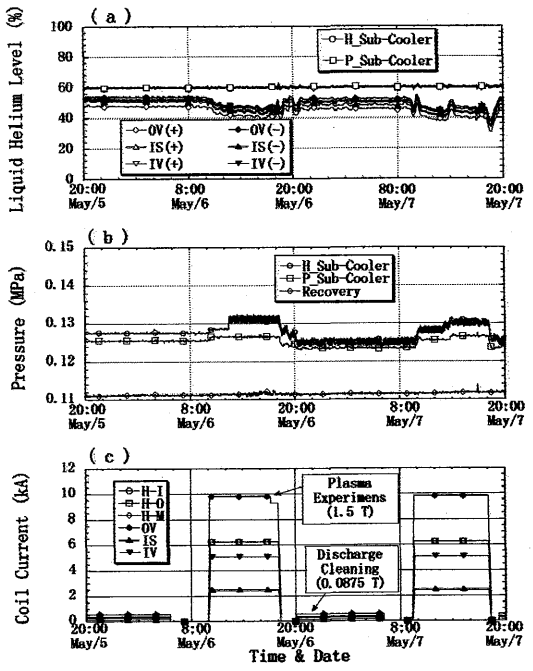

Fig. 2 Typical examples of steady state operation for the plasma experiments.

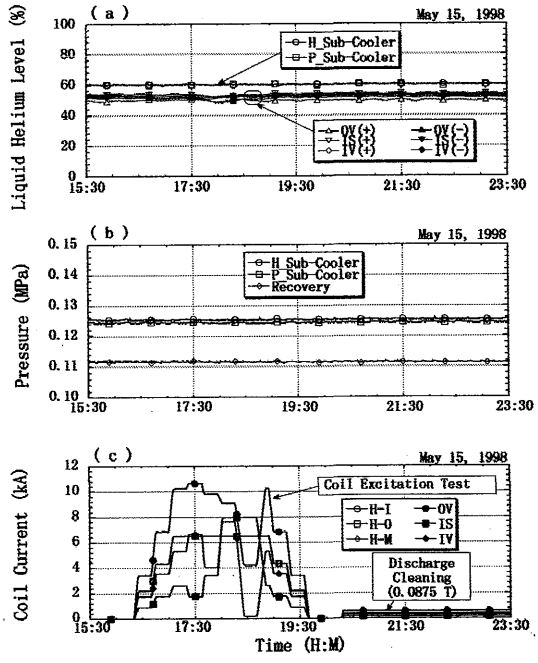

Fig. 3 Typical examples of stable operation for the current-leads.